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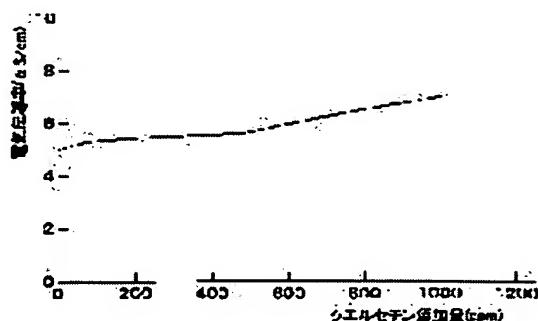
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(54) COOLING LIQUID, FILLING METHOD THEREOF AND COOLING SYSTEM

(57)Abstract:

PROBLEM TO BE SOLVED: To provide a cooling liquid for a fuel cell which possesses low electroconductivity, anticorrosive property, high heat conductivity and nonfreezing property as the cooling liquid for a fuel cell stack.

SOLUTION: This cooling liquid for a fuel cell stack comprises a base material made of a mixed solution consisting of water and glycols and an anticorrosive additive for maintaining the electroconductivity of the cooling liquid in such a way as to have low electroconductivity and also for maintaining the hydrogen ion exponent of the cooling liquid in such a way as to be approximately neutral. The anticorrosive additive may comprise at least either of an ethanolamine-based alkaline additive comprising triethanolamine, diethanolamine and



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monoethanolamine, and an acid additive selected from the group consisting of triazoles, phosphates and organophosphates.

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CLAIMS

[Claim(s)]

[Claim 1] Coolant which is coolant and contains the basis containing water, and the rust-proofing additive which maintains the hydrogen ion exponent of said coolant neutrally mostly while maintaining the conductivity of said coolant with low conductivity.

[Claim 2] It is the coolant characterized by being the mixed solution with which said basis contains glycols further in the coolant according to claim 1.

[Claim 3] It is the coolant characterized by said rust-proofing additive containing at least one side among a weak alkaline additive and a weak acidic additive in the coolant according to claim 1 or 2.

[Claim 4] It is the coolant characterized by said rust-proofing additive containing an alkaline additive and an acid additive in the coolant according to claim 1 or 2.

[Claim 5] It is the coolant characterized by said alkaline additive being the matter of an ethanolamine system in the coolant according to claim 4.

[Claim 6] It is the coolant characterized by said ethanolamine system matter containing triethanolamine, diethanolamine, and monoethanolamine in the coolant according to claim 5.

[Claim 7] It is the coolant characterized by being chosen from the group by which said acid additive is constituted from triazoles, phosphoric acids, and organic phosphoric acids in the coolant given in the claim of either claim 4 thru/or claim 6.

[Claim 8] It is the coolant characterized by said rust-proofing additive maintaining said coolant in a hydrogen ion exponent 6 [about] - about 9 range in the coolant given in the claim of either claim 1 thru/or claim 7.

[Claim 9] It is the coolant characterized by said rust-proofing additive maintaining said coolant to the low conductivity of under about 100microS/cm in the coolant given in the claim of either claim 1 thru/or claim 8.

[Claim 10] It is the coolant characterized by said rust-proofing additive having rust-proofing nature especially to an aluminum ingredient in the coolant given in the claim of either claim 1 thru/or claim 9.

[Claim 11] It is the coolant characterized by said rust-proofing additive being the Nonion system matter in the coolant according to claim 1.

[Claim 12] It is the coolant characterized by said Nonion system matter containing either [at least] a saccharide or a nonionic surface active agent in the coolant according to claim 11.

[Claim 13] It is the coolant characterized by being refined by the coolant purification system by which ion exchange resin was used for said coolant in the coolant according to claim 11 or 12.

[Claim 14] Said coolant is coolant characterized by performing deoxidation processing in the coolant given in the claim of either claim 1 thru/or claim 13.

[Claim 15] How to be an approach for enclosing the coolant given in the claim of either claim 1 thru/or claim 13 with the stack cooling circuit of a fuel cell, perform deoxidation processing to said coolant, and enclose with said cooling circuit said coolant by which deoxidation processing was carried out with inert gas.

[Claim 16] The cooling system of a fuel cell equipped with the cooling circuit where it is the stack cooling system of a fuel cell, and the coolant, and its coolant and inert gas of a publication are enclosed with the claim of either claim 1 thru/or claim 13.

[Claim 17] The manufacture approach of the coolant which is the manufacture approach of the

coolant, adjusts the basis containing water, adjusts the rust-proofing additive which maintains the hydrogen ion exponent of said coolant neutrally mostly while maintaining the conductivity of said coolant with low conductivity, mixes said basis and said rust-proofing additive, and refines the mixed solution of said basis and said rust-proofing additive using ion exchange resin.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]**[0001]**

[Field of the Invention] This invention relates to the coolant system which used the enclosure approach of the coolant and the coolant, and the coolant. It is related more with the cooling system of the approach of enclosing the coolant with the coolant for cooling a fuel cell in a detail, and the cooling circuit of a fuel cell cooling system, and a fuel cell.

[0002]

[Description of the Prior Art] Generally, the stack of a fuel cell is the laminating structure of two or more cells, and the cooling plate for cooling a stack (cell) for every substack which consists of cells of several layers is infix. The coolant path is formed in the interior of a cooling plate, and a stack is cooled when the coolant flows the coolant path. Thus, in order to prevent the decline (mitigation of an energy loss) in the generating efficiency which originates in the short circuit to the stack exterior, and resistance of the coolant since the coolant of a fuel cell circulates through between the inside of the stack which is performing the generation of electrical energy, i.e., a substack, the high insulating engine performance is required. In order to fill the demand of reservation of these insulation engine performance, reservation of cooling effectiveness, etc., with the conventional technique, pure water has been used as coolant. In order to maintain the life cycle of a cooling plate other than these demands for a long time, rust-proofing nature is also required of the coolant for fuel cell stacks. It has been coped with by using the high stainless steel ingredient of rust-proofing nature for a cooling plate, or generally, adding iron ion in the coolant to this demand, as indicated by JP,2-21572,A.

[0003]

[Problem(s) to be Solved by the Invention] However, although such a conventional solution could take effect to fixed [so-called], the inside of an installation mold and a large-sized fuel cell, and the fuel cell of a regular actuation mold, it was not necessarily able to say that it was effective to the small fuel cell of a non-installing mold called the fuel cell carried in a car, and the fuel cell of a intermittent-working mold, for example.

[0004] For example, since the coolant falls even to ambient temperature at the time of un-operating in the case of the fuel cell of an on-off operation mold and a non-installing mold, it is required under the conditions which ambient temperature becomes below the freezing point that it should have nonfreezing. It is because the cooling circuit containing a cooling plate etc. may receive damage when the coolant freezes. Moreover, when a cooling circuit receives damage, there is a possibility that a fuel cell may not fully demonstrate the function.

[0005] Here, when nonfreezing is taken into consideration, it is possible as coolant to use the coolant for internal combustion engine cooling as nonfreezing coolant. However, since the coolant for internal combustion engine cooling is used in the part which the electrical and electric equipment does not generate in essence, low conductivity is not taken into consideration but it has electric, very high conductivity. On the other hand, since the electrical and electric equipment is flowing to the cooling pipe of a fuel cell stack, if the conductivity of the coolant is high, the electrical and electric equipment produced with the fuel cell flows to the coolant, and **** the electrical and electric equipment. Therefore, as coolant which cools a fuel cell stack, it is unsuitable.

[0006] Moreover, lightweight-ization of the fuel cell system which includes a cooling circuit in the

case of the fuel cell of the non-installing molds for car loading etc. is an important conquest technical problem. Therefore, it is expected from a viewpoint of lightweight-izing that thermally conductive high light metals including for example, an aluminum ingredient are used for a cooling plate, a heat exchanger, etc. from now on. It is required that these light metals have as high rust-proofing nature as a stainless steel ingredient, and generally should not break it, therefore the coolant itself should have rust-proofing nature.

[0007] This invention is made in order to solve the above-mentioned problem, and it aims at offering the coolant of the fuel cell equipped with low conductivity, rust-proofing nature, high temperature convective, and nonfreezing as coolant for fuel cell stacks.

[0008]

[The means for solving a technical problem, and its operation and effectiveness] In order to solve the above-mentioned technical problem, the 1st mode of this invention offers the coolant containing the basis containing water, and the rust-proofing additive which maintains the hydrogen ion exponent of said coolant neutrally mostly while maintaining the conductivity of said coolant with low conductivity.

[0009] According to the 1st mode of this invention, the coolant which fulfills low conductivity, rust-proofing nature, high temperature convective, and nonfreezing is realizable.

[0010] In the coolant concerning the 1st mode of this invention, said basis may be a mixed solution which contains glycols further. An account rust-proofing additive may also contain at least one side among a weak alkaline additive and a weak acidic additive, or can contain an alkaline additive and an acid additive. Furthermore, said alkaline additive may be the matter of an ethanolamine system. Moreover, said ethanolamine system matter can contain triethanolamine, diethanolamine, and monoethanolamine.

[0011] Said acid additive can be chosen from the group which consists of triazoles, phosphoric acids, and organic phosphoric acids in the coolant concerning the 1st mode of this invention. Moreover, said rust-proofing additive may maintain said coolant in a hydrogen ion exponent 6 [about] - about 9 range. Furthermore, said rust-proofing additive may maintain said coolant to the low conductivity of under about 100microS/cm. Furthermore, said rust-proofing additive can have rust-proofing nature especially to an aluminum ingredient.

[0012] In the coolant concerning the 1st mode of this invention, said rust-proofing additive may be the Nonion system matter, and said Nonion system matter may also contain either [at least] a saccharide or a nonionic surface active agent. Moreover, said coolant may be refined by the coolant purification system which used ion exchange resin, and deoxidation processing may be performed further. When using the Nonion system matter as a rust-proofing additive, only the impurity which a rust-proofing additive does not ionize in the coolant, but is ionized by using ion exchange resin can be removed easily. Moreover, degradation of the quality of the coolant can be prevented over a long period of time by deoxidation processing.

[0013] The 2nd mode of this invention offers the approach for enclosing the coolant concerning the 1st mode of this invention with the stack cooling circuit of a fuel cell. This approach performs deoxidation processing to said coolant, and is characterized by enclosing with said cooling circuit said coolant by which deoxidation processing was carried out with inert gas.

[0014] According to the 2nd mode of this invention, degradation of the quality of the coolant in a cooling circuit can be prevented over a long period of time.

[0015] The 3rd mode of this invention offers the stack cooling system of a fuel cell. This cooling system is characterized by having the cooling circuit where the coolant concerning the 1st mode of this invention, and its coolant and inert gas are enclosed.

[0016] According to the 3rd mode of this invention, a cooling system can have low conductivity, rust-proofing nature, high temperature convective, and nonfreezing. Moreover, degradation of the quality of the coolant in a cooling circuit can be prevented over a long period of time.

[0017] The 4th mode of this invention offers the manufacture approach of the coolant. the 4th voice of this invention -- the manufacture approach of the coolant which starts like adjusts the basis containing water, it adjusts the rust-proofing additive which maintains the hydrogen ion exponent of said coolant neutrally mostly while it maintains the conductivity of said coolant with low conductivity, it mixes said basis and said rust-proofing additive, and is characterized by to refine the

mixed solution of said basis and said rust-proofing additive using ion exchange resin.

[0018] According to the manufacture approach of the coolant concerning the 4th mode of this invention, the coolant which fulfills low conductivity, rust-proofing nature, high temperature convective, and nonfreezing can be manufactured. In addition, in addition to water, glycols may be used on the occasion of adjustment of a basis. Moreover, on the occasion of adjustment of a rust-proofing additive, an alkaline additive and an acid additive may be used or you may adjust using the Nonion system matter.

[0019]

[Embodiment of the Invention] - Gestalt of implementation of the 1st invention : [0020] Hereafter, the coolant concerning this invention is explained with reference to Table 1 and 2.

[0021] First, the property of each coolant is explained with reference to Table 1. Table 1 shows pH to the presentation list of the coolant used in the 1st example according to this invention - the 9th example at the presentation list of the coolant of a hydrogen ion exponent (pH), and the example 1 of a comparison - the example 6 of a comparison. Table 2 shows the comparative study result of the coolant used in the 1st example shown in Table 1 - the 9th example, and the coolant of the example 1 of a comparison - the example 6 of a comparison. In addition, the 1st example - the 9th example are shown as an example 1 - an example 9 all over Table 1.

[0022]

[Table 1]

	実施例1	実施例2	実施例3	実施例4	実施例5	実施例6	実施例7	実施例8	実施例9	実施例10	実施例11	実施例12	実施例13	実施例14	実施例15	実施例16
■ エチレングリコール	50.00	50.00	30.00	50.00	50.00	50.00	50.00	50.00	50.00	50.00	50.00	50.00	50.00	50.00	-	-
■ フジバンジゴルゴン	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
■ ブリセリン	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
■ 鋼	48.80	49.85	49.80	49.85	49.80	49.80	49.50	49.80	49.80	49.80	49.80	49.78	50.00	50.00	-	-
■ 水道水	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	100.00
■ クリアセラジ	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
■ ブラックガラス(71%鉛)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
■ ガルバニズム	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
■ 71.4%ガラス	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
■ POE(PE:タモハニモハニ)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
■ ポリマー樹脂	1.00	0.34	-	-	-	-	-	-	-	-	-	-	-	-	-	-
■ 加水剤	0.10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
■ 本体化樹脂	-	0.005	-	-	-	-	-	-	-	-	-	-	-	-	-	-
■ ベンジルアミン	-	-	0.10	-	-	-	-	-	-	-	-	-	-	-	-	-
■ 選択的トリクム	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
■ ピリジン・酢酸トリクム	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
■ 安息香酸トリクム	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
■ 水酸ビリクム	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
■ 水素イオン濃度指数(pH)	8.1	8.1	8.1	6.2	7~8	7~8	7~8	7~8	7~8	7~8	7~8	7.3	6.8	6.8	6.8	6~7

The coolant of the 1st example contains triethanolamine (1.0 % of the weight) and orthophosphoric acid (0.1 % of the weight) as a rust-proofing additive including ethylene glycol (50 % of the weight) and ion exchange water (48.9 % of the weight) as a basis. Ethylene glycol is both common knowledge in propylene glycol at glycols as a group, then matter which brings a nonfreezing property to the solution for mixing. Moreover, the basis which are ion exchange water and the mixed solution of glycols is excellent in the heat-conduction property so that I may be understood also from generally being used as coolant for internal combustion engines of a car.

[0023] Here, triethanolamine is the alkaline rust-proofing additive of an ethanolamine system, and orthophosphoric acid is an acid rust-proofing oxidizer belonging to phosphoric acid. The coolant of this 1st example is pH8.1. In addition, triethanolamine can be added in 0.1 - 3.0% of the weight of the range from a viewpoint of rust-proofing engine-performance reservation and conductivity control, and orthophosphoric acid can be added in 0.1 - 1.0% of the weight of the range. In this case, the whole presentation is adjusted to 100% of the weight by adjusting weight % of ion exchange water. Moreover, it replaces with triethanolamine, and other ethanolamine system matter, such as monoethanolamine and diethanolamine, may be used, it may replace with orthophosphoric acid, and

other phosphoric acid matter may be used.

[0024] The coolant of the 2nd example contains triethanolamine (0.34 % of the weight) and phosphonic acid (0.005 % of the weight) as a rust-proofing additive including ethylene glycol (50 % of the weight) and ion exchange water (49.655 % of the weight) as a basis. Phosphonic acid is an acid rust-proofing oxidizer belonging to organic phosphoric acid. The coolant of this 2nd example is pH8.1. In addition, triethanolamine can be added in 0.1 - 3.0% of the weight of the range from a viewpoint of rust-proofing engine-performance reservation and conductivity control, and phosphonic acid can be added in 0.001 - 0.01% of the weight of the range. In this case, the whole presentation is adjusted to 100% of the weight by adjusting weight % of ion exchange water. Moreover, it replaces with triethanolamine, and other ethanolamine system matter, such as monoethanolamine and diethanolamine, may be used, it may replace with phosphonic acid, and other organic phosphoric acid matter may be used.

[0025] The coolant of the 3rd example contains benzotriazol (0.1 % of the weight) as a rust-proofing additive including ethylene glycol (50 % of the weight) and ion exchange water (49.9 % of the weight) as a basis. Benzotriazol is an acid rust-proofing oxidizer belonging to triazoles. The coolant of this 3rd example is pH6.2. In addition, benzotriazol can be added in 0.1 - 0.6% of the weight of the range from a viewpoint of rust-proofing engine-performance reservation and conductivity control. In this case, the whole presentation is adjusted to 100% of the weight by adjusting weight % of ion exchange water. Moreover, it may replace with benzotriazol and other triazoles may be used.

[0026] The coolant of the following example [4th] - the 9th example has the description at the point using the Nonion system matter which is not ionized in a water solution as a rust-proofing additive. A saccharide, a non-ion system surfactant, etc. are contained in the Nonion system matter.

[0027] The coolant of the 4th example contains as a basis the quercetin (3, 3', 4', 5, 7-pentahydroxyflavone) (0.05 % of the weight) which is the Nonion system matter as a rust-proofing additive, and is a kind of ***** including ethylene glycol (50 % of the weight) and ion exchange water (49.95 % of the weight). The coolant of this 4th example is pH 7-8. In addition, a quercetin can be added in 0.005 - 0.2% of the weight of the range from a viewpoint of rust-proofing engine-performance reservation and conductivity control. In this case, the whole presentation is adjusted to 100% of the weight by adjusting weight % of ion exchange water.

[0028] The coolant of the 5th example contains as a basis the glucose (0.10 % of the weight) which is a kind of monosaccharide as a rust-proofing additive including ethylene glycol (50 % of the weight) and ion exchange water (49.90 % of the weight). The coolant of this 5th example is pH 7-8. In addition, a glucose can be added in 0.05 - 0.5% of the weight of the range from a viewpoint of rust-proofing engine-performance reservation and conductivity control. In this case, the whole presentation is adjusted to 100% of the weight by adjusting weight % of ion exchange water.

[0029] The coolant of the 6th example contains as a basis the maltose (0.10 % of the weight) which is a kind of oligosaccharide as a rust-proofing additive including ethylene glycol (50 % of the weight) and ion exchange water (49.90 % of the weight). The coolant of this 6th example is pH 7-8.

[0030] The coolant of the 7th example contains as a basis the maltose (0.50 % of the weight) which is a kind of oligosaccharide as a rust-proofing additive including ethylene glycol (50 % of the weight) and ion exchange water (49.50 % of the weight). The coolant of this 7th example is pH 7-8.

[0031] The coolant of the 8th example contains as a basis the alkyl glucoside (0.10 % of the weight) which is a kind of a non-ion system surfactant as a rust-proofing additive including ethylene glycol (50 % of the weight) and ion exchange water (49.90 % of the weight). The coolant of this 8th example is pH 7-8. In addition, alkyl glucoside can be added in 0.05 - 0.5% of the weight of the range from a viewpoint of rust-proofing engine-performance reservation and conductivity control. In this case, the whole presentation is adjusted to 100% of the weight by adjusting weight % of ion exchange water.

[0032] The coolant of the 9th example contains as a basis the polyoxyethylene (POE) sorbitan monopalmitate (0.10 % of the weight) which is a kind of a non-ion system surface active agent as a rust-proofing additive including ethylene glycol (50 % of the weight) and ion exchange water (49.90 % of the weight). The coolant of this 9th example is pH 7-8. In addition, POE sorbitan monopalmitate can be added in 0.05 - 0.5% of the weight of the range from a viewpoint of rust-proofing engine-performance reservation and conductivity control. In this case, the whole

presentation is adjusted to 100% of the weight by adjusting weight % of ion exchange water.

[0033] In addition, with the gestalt of operation of this invention, when a fuel cell was carried in a car, in consideration of aluminum and an aluminium alloy being used for a cooling plate list as the quality of the materials, such as a heat exchanger in a cooling circuit, the anti-corrosiveness especially to an aluminum ingredient etc. was taken into consideration. In case a fuel cell is mounted, it is because it is thought that the aluminum ingredient by which current is used abundantly at the radiator for cars etc. as an ingredient which lightweight-izing and low cost-ization etc. will be required and can meet these demands is suitable.

[0034] Therefore, the rusr-proofer in which each rust-proofing additive used in the 1st example - the 9th example is instantiation to the last, in addition good rust-proofing nature is shown to an aluminum ingredient may be used. Or [0035] which should just use the rust-proofing additive equipped with rust-proofing nature to the ingredient used in case ingredients other than an aluminum ingredient are used. The coolant of the example 1 of a comparison is coolant generally used for internal combustion engine cooling of an automobile, and contains orthophosphoric acid (0.2 % of the weight), benzotriazol (0.1 % of the weight), a sodium nitrate (0.1 % of the weight), sodium molybdate (0.2 % of the weight), sodium benzoate (2.5 % of the weight), and a sodium hydroxide (0.12 % of the weight) as a rust-proofing additive including ethylene glycol (50 % of the weight) and ion exchange water (46.78 % of the weight) as a basis. pH of the coolant of the example 1 of a comparison is 7.3.

[0036] The coolant of the example 2 of a comparison was coolant containing ethylene glycol (50 % of the weight) and ion exchange water (50 % of the weight), and it was used in order to examine the property of an ethylene glycol-ion-exchange-water system in case a rust-proofing additive is not included. This cooling water is pH6.8.

[0037] The coolant of the example 3 of a comparison was coolant containing propylene glycol (50 % of the weight) and ion exchange water (50 % of the weight), and it was used in order to examine the property of a propylene glycol-ion-exchange-water system in case a rust-proofing additive is not included. This cooling water is pH6.8.

[0038] The coolant of the example 4 of a comparison is coolant containing a glycerol (50 % of the weight) and ion exchange water (50 % of the weight), and was used for comparison reference.

[0039] The example 5 of a comparison was common tap water (100 % of the weight), and it was used in order to examine the property of tap water.

[0040] Conventionally, the example 6 of a comparison is ion exchange water (100 % of the weight) used as coolant for fuel cell cooling, and was used for comparison reference.

[0041] Without using pH regulators (for example, potassium hydroxide etc.) like before in pH adjustment in each above-mentioned example and the example of a comparison, by adjusting the addition of a rust-proofing additive, it adjusted so that it might fit in the range of pH 6-9. In addition, pH measurement was carried out at 25 degrees C using commercial pH measuring instrument.

[0042] Next, Table 2 is referred to, and the result of various comparative studies is explained and examined. Table 2 shows the various test results to the example 1 of a comparison - the example 6 of a comparison to the 1st example enumerated to Table 1 - the 9th example, and a list.

[0043]

[Table 2]

First, it compares about the test result of conductivity (electrical conductivity) ($\mu\text{S}/\text{cm}$). It is the trial which this conductivity trial switches on two electrodes in the coolant of a test objective, and measures the ease of flowing of the current in inter-electrode [these], and that approach is common knowledge for this contractor. In addition, in the gestalt of operation of this invention, it measured under conditions of 25 degree C of commercial **** for conductivity meters. In addition, the 1st example - the 9th example are shown as an example 1 - an example 9 all over Table 2.

[0044] First, when the example 1 of a comparison which is the coolant conventionally used for internal combustion engine cooling of an automobile was examined, conductivity is 5960 (μS/cm) and showed very high conductivity as compared with each of other example and the example of a comparison. It is considered to be the cause that this contains the strong-electrolyte matter with which the example 1 of a comparison brings about conductivity also with high minute amounts, such as a sodium hydroxide and a sodium nitrate, as an additive. In addition, there are a sodium hydroxide, a potassium hydroxide, etc. in the matter which there are a sodium nitrate, sodium molybdate, sodium benzoate, etc. in the matter conventionally used widely as a rust-proofer, and has been used as a neutralizer of a solution.

[0045] Moreover, the example 5 of a comparison also contained various ion on the property, and the

high conductivity 286 (muS/cm) was shown. On the other hand, since the example 4 of a comparison hardly had ion, it showed the comparatively low conductivity 1.8 (muS/cm). Moreover, since the ion exchange water (example 6 of a comparison) conventionally used as coolant for fuel cells hardly contained ion, it showed the lowest conductivity 0.88 (muS/cm).

[0046] the conductivity 3.46 (muS/cm) of the example 2 of a comparison this conductivity of whose the conductivity of the 2nd example is 5.01 (muS/cm) and is the basis of the coolant of the 2nd example, and the value to approximate -- moreover, the value near the conductivity 1.63 (muS/cm) of the example 3 of a comparison containing the propylene glycol belonging to the same glycols was shown.

[0047] Moreover, the conductivity of the 3rd example is 2.11 (muS/cm) and this conductivity showed the almost same value as the conductivity 1.63 (muS/cm) of the example 3 of a comparison containing the propylene glycol belonging to the conductivity 3.46 (muS/cm) and the same glycols of the example 2 of a comparison which are the basis of the coolant of the 3rd example.

[0048] Addition of the additive which is the electrolyte matter which increases the ion concentration in a solution usually tends to increase conductivity. However, the conductivity change by addition of an additive can be disregarded in the coolant in the 2nd example and the 3rd example.

[0049] The conductivity of the 4th example and the 7th example is 5.3 (muS/cm) and 5.0 (muS/cm), respectively, and this conductivity showed the conductivity 3.46 (muS/cm) of the example 2 of a comparison which is the basis of the coolant of the 4th example and the 7th example, and the value to approximate.

[0050] The conductivity of the 5th example, the 6th example, the 8th example, and the 9th example is 3.6 (muS/cm) and 3.5 (muS/cm) 3.2 (muS/cm) 4.4 (muS/cm), respectively, and this conductivity showed the almost same value as the conductivity 3.46 (muS/cm) of the example 2 of a comparison which is the basis of the coolant of the 5th, 6th, 8th, and 9th examples.

[0051] Since the rust-proofing additive used for the 4th example - the 9th example is the matter of the Nonion system which is not ionized in a solution, taking the same value as the conductivity which a solvent has theoretically is expected. In the 4th example as an experimental result - the 9th example, indicating mostly the same or the value approximated extremely to be the conductivity which a solvent has was checked also in which example. Therefore, the conductivity change by addition of an additive can be disregarded in the coolant in the 4th example - the 9th example.

[0052] Here, the relation of the addition and conductivity is explained with reference to drawing 1 about the quercetin used as a rust-proofing additive in the 4th example. Drawing 1 is a graph which shows transition of the conductivity at the time of adding a quercetin to an ethylene glycol 50% diluent, an axis of abscissa shows a quercetin addition (ppm), and an axis of ordinate shows conductivity (muS/cm). To 700 ppm, conductivity is about 5-6 (muS/cm), and the quercetin addition shows the conductivity 3.5 (muS/cm) which does not depend on an addition but a solvent (for example, example 2 of a comparison) shows, and the approximated conductivity so that I may be understood from drawing 1. Moreover, although conductivity increases even after a quercetin addition exceeds 700 ppm, the value is about 7 (muS/cm) in the quercetin addition of 1000 ppm. Therefore, it is understood that the quercetin which is the Nonion system matter is not based on the addition, but low conductivity is shown, and it can be said that it is the rust-proofing additive good for the coolant with which low conductivity is demanded.

[0053] Although the conductivity of the 1st example is 29.0 (muS/cm) and is high as compared with the conductivity (5.01 (muS/cm) 3.46 (muS/cm)) of the example 2 of a comparison, and the example 3 of a comparison, the value is 1/10 of the example 5 of a comparison, and is 1/100 or less [of the example 1 of a comparison] further.

[0054] Thus, since pH adjustment of the coolant concerning the 1st example - the 3rd example is adjusted using the acidity which a rust-proofing additive has, and an alkaline property, the conductivity of the coolant is maintained by the very low value as compared with the case where pH regulator is used. Moreover, since the rust-proofing additive of the cooling water concerning the 4th example - the 9th example is the Nonion system matter while being neutrality, it can maintain the conductivity of the coolant to the almost same value as the conductivity of a solvent, without carrying out pH adjustment.

[0055] Next, it compares about the passivation current density (passivation holding current)

($\mu\text{A}/\text{cm}^2$) which is the current by which a test objective metal is passivated. In this trial, the aluminum ingredient (AC2A) which is a test sample was used for one electrode, the platinum electrode was used for the electrode of another side, it dipped into each coolant (88 degrees C, 300ml) which shows two electrodes in Table 1, bubbling was performed by N210 ml/min, and the current which flows between two electrodes where deoxidation processing is performed to the coolant was measured. In case a trial ingredient electrolyzes, the magnitude of the current generated in per unit area is shown, generally, a trial ingredient is easy to begin to melt, so that current density is high, namely, current density means that it is easy to be corroded. Therefore, an exam means that the corrosion rate of an aluminum ingredient is so high that current density is high.

[0056] In addition, at the time of the measurement about the 4th example which bundles measured value with a parenthesis all over Table 2 - the 9th example, and the example 2 of a comparison - the example 4 of a comparison, 50 ppm HCO_3^- was added as a directions electrolyte, and measurement was performed. In what added 50 ppm HCO_3^- as a directions electrolyte, since HCO_3^- (ion) is dissolved, the value of current density is high.

[0057] Moreover, the experiment under Air aeration was also conducted about the 1st example - the 3rd example, the example 1 of a comparison - the example 3 of a comparison, and the example 5 of a comparison.

[0058] the 1st example -- the bottom of N2 aeration -- the bottom of 4.8 ($\mu\text{A}/\text{cm}^2$) and Air aeration -- 2.4 ($\mu\text{A}/\text{cm}^2$) and the 2nd example -- 12 ($\mu\text{A}/\text{cm}^2$) and the 3rd example showed the passivation current density of 2.4 ($\mu\text{A}/\text{cm}^2$) under 2.4 ($\mu\text{A}/\text{cm}^2$) and Air aeration under N2 aeration under 11 ($\mu\text{A}/\text{cm}^2$) and Air aeration under N2 aeration, respectively. Moreover, in the 4th example, 7 ($\mu\text{A}/\text{cm}^2$) and the 5th example showed 15 ($\mu\text{A}/\text{cm}^2$), and the 6th example showed the passivation current density of 16 ($\mu\text{A}/\text{cm}^2$), respectively. Furthermore, in the 7th example, 16 ($\mu\text{A}/\text{cm}^2$) and the 8th example showed 60 ($\mu\text{A}/\text{cm}^2$), and the 9th example showed the passivation current density of 80 ($\mu\text{A}/\text{cm}^2$).

[0059] on the other hand, the example 1 of a comparison -- the bottom of N2 aeration -- the bottom of 3.0 ($\mu\text{A}/\text{cm}^2$) and Air aeration -- 3.0 ($\mu\text{A}/\text{cm}^2$) and the example 2 of a comparison -- 2.0 ($\mu\text{A}/\text{cm}^2$) and the example 3 of a comparison showed the passivation current density of 1.3 ($\mu\text{A}/\text{cm}^2$) under 100 ($\mu\text{A}/\text{cm}^2$) and Air aeration under N2 aeration under 100 ($\mu\text{A}/\text{cm}^2$) and Air aeration under N2 aeration, respectively. Moreover, as for the example 4 of a comparison, 100 ($\mu\text{A}/\text{cm}^2$) and the example 5 of a comparison showed the passivation current density of 210 ($\mu\text{A}/\text{cm}^2$) under 76 ($\mu\text{A}/\text{cm}^2$) and Air aeration under N2 aeration, respectively.

[0060] Therefore, it can be said that the coolant concerning the 1st example - the 7th example is coolant which an aluminum ingredient cannot corrode easily as compared with the coolant of the example 2 of a comparison thru/or the example 5 of a comparison. In spite of containing the directions electrolyte especially in the coolant concerning the 4th example - the 7th example, very low passivation current density is shown, and it is understood that it is the coolant which cannot corrode an aluminum ingredient easily essentially.

[0061] Moreover, it can be said that it is coolant which an aluminum ingredient cannot corrode easily if it compares with the example 2 of a comparison thru/or the example 4 of a comparison although the coolant concerning the 8th example and the 9th example will take a higher value if it compares with the coolant concerning the 1st example - the 7th example. In addition, although the coolant of the example 1 of a comparison which does not contain a directions electrolyte shows low passivation current density almost equivalent to the coolant concerning the 1st example which does not contain a directions electrolyte similarly - the 3rd example, since the conductivity is very high, it is as stated above that is not suitable as coolant. Furthermore, if it results in the coolant of the example 5 of a comparison, since passivation current density is also high as compared with the coolant concerning the 1st example - the 3rd example and the conductivity is also high, it is not suitable as coolant.

[0062] At the last, the trial which measures the corrosion weight loss (the decrease of mass per unit area: mg/cm^2) of the aluminum ingredient in the coolant is considered the metal protection sex test and here. This trial was performed by leaving an aluminum ingredient under air aeration in each cooling solution heated by 88 degrees C for 360 hours. Moreover, this trial was carried out twice under Air aeration about the 1st example - the 7th example and the example 1 of a comparison - the

example 3 of a comparison, the example 5 of a comparison, and the example 6 of a comparison, and was carried out twice under N2 aeration about the 1st example, the 3rd example, and the example 3 of a comparison. The negative value of a metal protection trial of front Naka means that the aluminum ingredient was corroded, an aluminum ingredient is not corroded but others mean that a certain matter adhered to the front face.

[0063] The example 5 of a comparison in which we are most anxious about corrosion showed the 1st - 0.52 (mg/cm²) or 2nd amount of corrosion of -0.43 (mg/cm²). Moreover, the example 2 of a comparison which is the basis of each example showed the 1st - 0.12 (mg/cm²) or 2nd amount of corrosion of 0.10 (mg/cm²), and the example 3 of a comparison containing the propylene glycol contained in glycols showed the 1st - 0.12 (mg/cm²) or 2nd amount of corrosion of 0.09 (mg/cm²).

[0064] On the other hand, the 1st example showed the 1st time and the 0.01 (mg/cm²) or 2nd amount of corrosion of -0.01 (mg/cm²), the 2nd example showed [both] the 1st amount [2nd] of corrosion of -0.04, and the 3rd example showed the 1st time and the 0.04 (mg/cm²) or 2nd amount of corrosion of 0.15 (mg/cm²). The 4th example shows the 1st - 0.02 (mg/cm²) or 2nd amount of corrosion of 0.01 (mg/cm²). The 5th example Both the 1st amounts [2nd] of corrosion of -0.02 (mg/cm²) are shown. The 6th example The 1st - 0.03 (mg/cm²) or 2nd amount of corrosion of -0.01 (mg/cm²) were shown, and the 7th example showed the 1st time and the 0.00 (mg/cm²) or 2nd amount of corrosion of -0.02 (mg/cm²).

[0065] Therefore, also in which example of the 1st - the 7th example, while it is much less than the numeric value which the example 4 of a comparison showed, it turns out that anti-corrosiveness is raised also in contrast with the example 2 of a comparison which is the basis.

[0066] In addition, both the examples 6 of a comparison showed the 1st amount [2nd] of corrosion of 0.10 (mg/cm²), and the example 1 of a comparison showed the 1st - 0.02 (mg/cm²) or 2nd amount of corrosion of 0.03 (mg/cm²).

[0067] Even if it compares with the example of these comparisons, each example shows the almost equivalent amount of corrosion, or the smaller amount of corrosion.

[0068] Next, the amount of corrosion under N2 aeration to the coolant concerning the 1st example, the 3rd example, and the example 3 of a comparison is examined. The 1st example showed the 1st time and the 0.00 (mg/cm²) or 2nd amount of corrosion of -0.01 (mg/cm²), the 3rd example showed the 1st time and the 0.04 (mg/cm²) or 2nd amount of corrosion of 0.05 (mg/cm²), and the example 3 of a comparison showed the 1st time and the 0.02 (mg/cm²) or 2nd amount of corrosion of 0.04 (mg/cm²).

[0069] As compared with the case of Air aeration, the result same about the 1st example was obtained in each [these] amount of corrosion, and the almost same result was obtained about the 3rd example. On the other hand, in the example 3 of a comparison, the result by which corrosion was prevented by N2 aeration was obtained. That is, the dissolved oxygen in the coolant decreased and it was shown by carrying out deoxidation processing which blows inert gas, such as nitrogen (N₂), that the corrosion of an aluminum ingredient can be controlled. Therefore, the corrosion of the aluminum ingredient used as an ingredient which forms a coolant circuit can be prevented by carrying out deoxidation processing of the coolant using nitrogen gas etc.

[0070] If it looks back upon the above comparative study result, in each test result of conductivity and corrosion weight loss, the coolant of the example 6 of a comparison, i.e., the ion exchange water used so far, (pure water) shows the good numeric value. However, ion exchange water will be frozen under the environment below the freezing point. Therefore, when ion exchange water is used as coolant, an anti-freeze circuit must be earned on the fuel cell which may be put on the bottom of the environment below the freezing point, and an anti-freeze circuit must always be operated with it. However, it is difficult to prepare an anti-freeze circuit to the fuel cell of a non-installing mold and a intermittent-working mold. Although carried out, it is unsuitable to use ion exchange water for the fuel cell of **, the non-installing mold which may be put on the bottom of the environment below the freezing point, and a intermittent-working mold.

[0071] Moreover, although the coolant of the example 1 of a comparison, i.e., the coolant for the conventional internal combustion engine cooling, shows a good result about nonfreezing, rust-proofing nature, etc., the conductivity is very high and unsuitable for the coolant for fuel cell stack cooling as which the low conductivity engine performance is required.

[0072] Furthermore, although the coolant which uses the coolant of the example 2 of a comparison and the example 3 of a comparison, i.e., the basis of the 1st example - the 3rd example, and a basis equivalent to the basis as all components shows a result good about conductivity and nonfreezing, it is unsuitable as coolant for fuel cell stack cooling from a viewpoint of anti-corrosiveness (rust-proofing nature).

[0073] Therefore, it turns out from a viewpoint of nonfreezing, rust-proofing nature, conductivity, and thermal conductivity that the presentation of the coolant of the 1st example - the 9th example is suitable as coolant for fuel cell stacks.

[0074] Although the above-mentioned pH measurement and the above-mentioned conductivity trial were performed under 1atm and 25-degree C conditions and the metal protection trial and the passivation current density trial were performed under 1atm and 88-degree C conditions, not only in the bottom of these pressures and temperature but a service condition, for example, 1 - 1.9atm, and -35 degree-C-100 degree C, it is desirable to adjust an additive so that it may become under about 100microS/cm about about 6 - about 9 conductivity in pH.

[0075] Moreover, although the coolant was adjusted using weak acidic benzotriazol in the 3rd example, the coolant may be adjusted to desired rust-proofing nature, conductivity, and pH using the additive of a weak alkaline ethanolamine system.

[0076] In addition, the freezing temperature of the 1st example - the 9th example, and the example 1 of a comparison - the example 3 of a comparison was 30 below the freezing point degrees C, and the freezing temperature of the example 5 of a comparison and the example 6 of a comparison was 0 degree C.

[0077] - Gestalt of implementation of the 2nd invention : [0078] The gestalt of implementation of the 2nd invention explains the coolant which is each example of the gestalt of implementation of the 1st invention with reference to drawing 2 and drawing 3 about the stack cooling system of the fuel cell which it has as a refrigerant. Drawing 2 is the fuel cell stack cooling structure-of-a-system Fig. where the gestalt of operation of this invention may be applied. Drawing 3 is the decomposition perspective view showing the laminated structure of a cell 20.

[0079] The stack 12 of a fuel cell 10 consists of two or more cells 20 by which laminating arrangement was carried out. The cell 20 is equipped with the separator 24 made from substantia-compacta carbon arranged at the lateral surface of the matrix (electrolyte) 23 inserted into the air pole 21, the fuel electrode 22, the air pole 21, and the fuel electrode 22, a fuel electrode 22, and an air pole 21. And whenever several layers of this cell 20 are accumulated, the cooling separator 30 made from aluminum is arranged on a separator 24.

[0080] In this example, the separator 24 is constituted as the edge separator 40 or the central separator 50. The cooling separators 30 and these separators 40 and 50 are formed in tabular [a tabular laminating side is a square-like]. The coolant holes 81 and 82 with a circular cross section are formed in the cooling separator 30, the edge separator 40, and the central separator 50 at two places (up both corners in drawing 3) of the periphery. When these coolant holes 81 and 82 form the above-mentioned stack, they form the passage of the coolant which penetrates a stack in the direction of a laminating. Moreover, the fuel gas holes 83 and 84 of a long and slender pair and the oxidation gas eyes 85 and 86 of a pair are formed near the edge of each side of the laminating side of the three above-mentioned kinds of separators along each side. When these fuel gas holes 83 and 84 and the oxidation gas eyes 85 and 86 form a stack, they penetrate and form the passage of the oxidation gas containing the fuel gas containing hydrogen, and oxygen in the direction of a laminating of a stack.

[0081] This cooling separator 30 is connected with the external cooling circuit 32 through a coolant path, and the cooling circuits 34 including the cooling separator 30 are constituted. The oxidization gas eye 85 which counters, and two or more groove parallel ribs 63 which connect between 86 are formed in one side (rear-face side in drawing 3) of the cooling separator 30. When a rib 63 forms a stack, it forms an oxidation gas passageway between the adjoining air poles 21. moreover, the cooling separator 30 -- on the other hand (transverse-plane side in drawing 3) -- *** -- the coolant hole 81 mentioned already and the meandering slot 87 which connects between 82 are formed. In case a stack is formed, the cooling separator 30 adjoins the edge separator 40, and a slot 87 forms a cooling liquid route between the flat fields of the edge separator 40 at this time.

[0082] The fuel gas hole 83 which counters, and two or more groove parallel ribs 62 which connect

between 84 are formed in one side (transverse-plane side in drawing 3) of the edge separator 40. When a rib 62 forms a stack, it forms fuel gas passage between the adjoining fuel electrodes 22. It is the flat field of the edge separator 40 which does not have slot structure on the other hand (rear-face side in drawing 3).

[0083] The fuel gas hole 83 which counters, and two or more groove parallel ribs 62 which connect between 84 are formed in one side (transverse-plane side in drawing 3) of the central separator 50. When a rib 62 forms a stack, it forms fuel gas passage between the adjoining fuel electrodes 22. the central separator 50 -- on the other hand (rear-face side in drawing 3) -- **** -- between the oxidation gas eye 85 which counters, and 86 is connected, and two or more groove ribs 63 which intersect perpendicularly with a rib 62 are formed. When a rib 63 forms a stack, it forms an oxidation gas passageway between the adjoining air poles 21.

[0084] In addition, although [the above-mentioned separator 24 (40 50)] formed with substantia-compacta carbon, it is good also as forming by other members which have conductivity. For example, rigidity and heat-conducting characteristic may be thought as important and you may form with metals, such as a copper alloy and an aluminium alloy.

[0085] In case [both] the coolant (namely, coolant of the 1st example - the 9th example) concerning the gestalt of implementation of the 1st invention is used for the coolant in a cooling circuit and these coolant is enclosed in a cooling circuit 34, inert gas, for example, nitrogen gas, is enclosed.

Therefore, the air in a cooling circuit 34 and the dissolved oxygen in the coolant are permuted by nitrogen gas, and degradation of the coolant resulting from dissolved oxygen is prevented. This is supported by the test result in the gestalt of implementation of the 1st invention.

[0086] - gestalt [of implementation of the 3rd invention]: -- the mode of implementation of the 3rd invention -- drawing 4 -- referring to -- the voice of implementation of the 1st invention -- explain the manufacture approach of the coolant which starts like. Drawing 4 is the explanatory view showing the outline of a process of manufacturing the coolant concerning the mode of implementation of the 1st invention.

[0087] First, a basis is adjusted using ion exchange water and ethylene glycol. For example, the addition of a rust-proofing additive is also taken into consideration and adjusted so that ethylene glycol may become 50 % of the weight in the coolant after manufacture (process 1). Then, a rust-proofing additive is adjusted using the Nonion system matter, using an alkaline additive and an acid additive (process 2). The chemical stated with the gestalt of implementation of the 1st invention as a rust-proofing additive can be used. For example, when adjusting the rust-proofing additive of the 1st example, it is adjusted so that triethanolamine may become 1.0 % of the weight in the coolant after manufacture and orthophosphoric acid may become 0.1 % of the weight.

[0088] After adjusting a basis and a rust-proofing additive, a basis and a rust-proofing additive are mixed and it considers as a mixed solution (process 3). On the occasion of mixing, churning may be performed to coincidence. Finally, the ion-exchange-resin film is used, a mixed solution is filtered (purification), and the quality of an ion ghost in a mixed solution is removed (process 4). The mixed solution refined with the ion-exchange-resin film turns into coolant concerning the gestalt of implementation of the 1st invention.

[0089] According to this manufacture approach, the coolant suitable as coolant for fuel cell stacks can be manufactured from a viewpoint of nonfreezing, rust-proofing nature, conductivity, and thermal conductivity.

[0090] In addition, when ion exchange resin refines, you may refine using the ion-exchange-resin film and fibrous ion exchange resin, and may refine through refined liquid in the column filled with an ion-exchange-resin particle. Moreover, predetermined time churning of the mixed liquor and ion exchange resin of a basis and a rust-proofing additive may be carried out, and the filtration membrane made from PTFE may refine mixed liquor. Before refining mixed liquor in using ion exchange resin, it is good to remove the metal ion which is processed with an acid solution (for example, concentrated hydrochloric acid) and by which ion exchange resin is adsorbed.

[0091] As mentioned above, although the fuel cell coolant which starts this invention based on the gestalt of implementation of some invention has been explained, the above-mentioned gestalt of implementation of invention is for making an understanding of this invention easy, and does not limit this invention. This invention is natural while changing and improving that of the equivalent

being contained in this invention, without deviating from a claim in the meaning list.

[0092] For example, the ratio of each presentation component used in each example of the gestalt of implementation of invention of the above 1st is instantiation, for example, triethanolamine is 0.1 - 3.0% of the weight of the range, orthophosphoric acid is 0.1 - 1.0% of the weight of the range, phosphonic acid is 0.001 - 0.01% of the weight of the range, and benzotriazol may have nonfreezing [desired], rust-proofing nature, conductivity, and thermal conductivity in 0.1 - 0.6% of the weight of the range, respectively.

[0093] Moreover, although each example takes the value of 6.2 and 8.1 also about a pH value, when using especially an aluminum ingredient for a cooling circuit, an aluminum ingredient is not corroded even if it takes the value of the range of pH 6-9.

[0094] Furthermore, the fuel cell stack cooling structure-of-a-system Fig. used on the occasion of explanation of the gestalt of implementation of the 2nd invention is instantiation, and if it is a cooling system equipped with the coolant concerning the gestalt of implementation of the 1st invention enclosed with inert gas as a refrigerant of a cooling circuit, it will not be restricted to this.

[0095] Moreover, especially in the gestalt of implementation of each above-mentioned invention, pH of each rust-proofing additive and the coolant was determined supposing an aluminum ingredient being used for the cooling circuit containing a cooling plate. However, what is necessary is just to realize pH demanded using the suitable rust-proofing additive for the ingredient used, when an ingredient is not prevented from other being used for a cooling circuit and other ingredients are used.

[Translation done.]

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DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1] It is the graph which shows transition of the conductivity at the time of adding a quercetin to an ethylene glycol 50% diluent.

[Drawing 2] It is the fuel cell stack cooling structure-of-a-system Fig. where the gestalt of implementation of the 2nd invention may be applied.

[Drawing 3] It is the decomposition perspective view showing the laminated structure of a cell 20.

[Drawing 4] It is the explanatory view showing the outline of a process of following the gestalt of implementation of the 3rd invention and of manufacturing the coolant concerning the mode of implementation of the 1st invention.

[Description of Notations]

10 -- Fuel cell
12 -- Stack
20 -- Cell
21 -- Air pole
22 -- Fuel electrode
23 -- Matrix
24 -- Separator
30 -- Cooling separator
32 -- External cooling circuit
34 -- Cooling circuit
40 -- Edge separator
50 -- Central separator
62 63 -- Rib
81 82 -- Coolant hole
83 84 -- Fuel gas hole
85 86 -- Oxidation gas eye
87 -- Slot

[Translation done.]

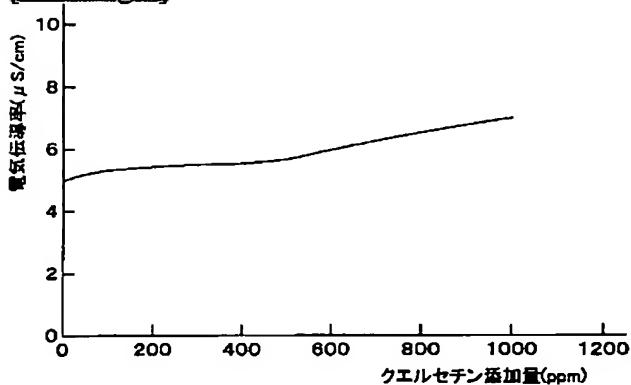
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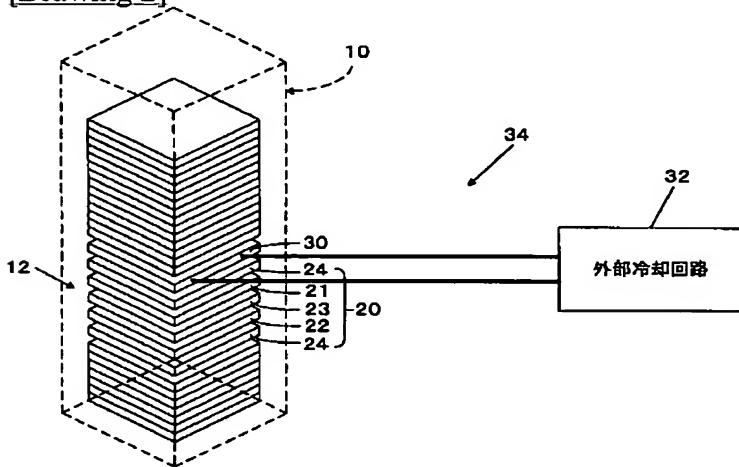
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DRAWINGS

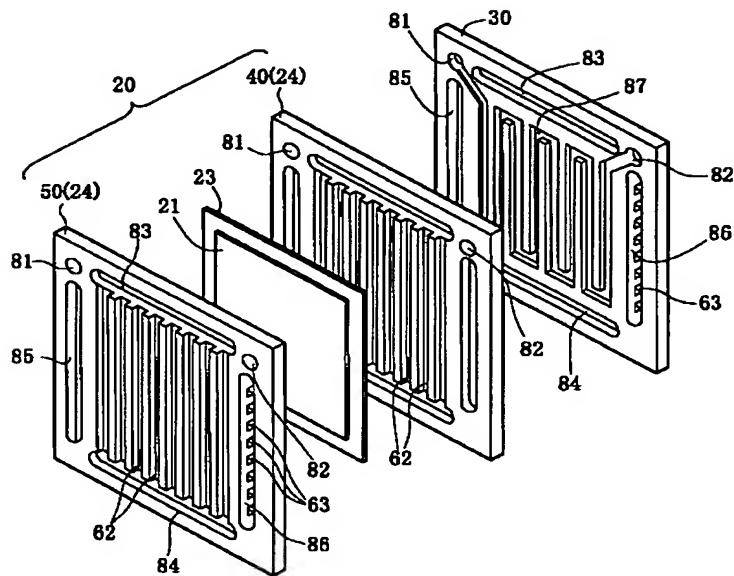
[Drawing 1]



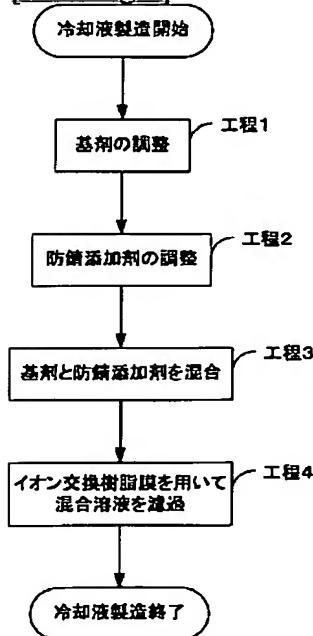
[Drawing 2]



[Drawing 3]



[Drawing 4]



[Translation done.]

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(54)【発明の名稱】冷却液、冷却液の注入方法および冷却システム

最終頁に続く

(57)【要約】

燃料電池スタック用の冷却液として低導電性、防漏性、高熱伝導性および不凍性を備える燃料電池の冷却液を提供する。

〔解決手段〕燃料電池スタック冷却用の冷却液は、水とグリコール類の混合物からなる基剤と、冷却液の導電率を低減する低導電性の水素イオン交換膜を含有する。

〔問題〕

〔発明の詳細な説明〕

(1)【発明の概要】

(2)【発明の発明の範囲】

(3)【発明の効果】

(4)【発明の実施例】

(5)【発明の実施例】

(6)【発明の実施例】

(7)【発明の実施例】

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-2 1 5 7 号公報に開示されているように冷却液中に鉄イオンを添加することによって処理されてきた。

(0 0 0 3)

(発明が解決しようとする問題) しかしながら、このよ

うな結果の対処方法は、いわゆる固定式、設置型の中、

大型燃料電池、常時作動型の燃料電池に対しては効果を

衰し得るが、例えば、並列に搭載される燃料電池といっ

た非設置型の小型の燃料電池、間欠作動型の燃料電池に

対しては必ずしも有効であるとはいへなかった。

(0 0 0 4) 例えは、間欠作動型、非設置型の燃料電池

の場合、冷却液が底点以下となる条件下では不活性を保

えることが要求される。燃料電池が連結した場合には、冷

却液を含む冷却回路が損傷を受けることがあるからで

ある。また、冷却回路が損傷を受ける場合には、燃料電

池がその機能を十分に発揮しないことがある。

(0 0 0 5) ここで、不活性を考慮した場合、例えば、

冷却液として、内燃機関用冷却液の冷却液を不活性冷却液

として使用することが考えられる。ところが、内燃機

関冷却用の冷却液は本質的に電気の発生を防ぐ部分にお

いて用いられるため、低導電性が要求されておらず、極

めて高い電気導通率を有している。一方、燃料電池スタ

ックの冷却管には電気が流れているため、冷却液の電気

伝導率が高いと燃料電池で生じた電気が冷却液へと流

れ、電気を放出する。したがって、燃料電池スタックを

冷却する冷却液としては不適当である。

(0 0 0 6) また、並列搭載時の非設置型の燃料電池

の場合には、冷却回路を含む燃料電池システムの底点か

は重要な克服課題である。したがって、底点化の観点か

ら、今後は冷却液、然交換器等、例えば、アルミニウ

ム材料をはじめとする熱伝導性の高い金属が用いられ

ることが予想される。これで重金属は、一般的に、ステ

ンレス材料ほど高い不活性を有しむら、したがって、

冷却液自身が耐久性を有することが要求される。

(0 0 0 7) 本発明は、上記問題を解決するためになさ

れたのであり、燃料電池スタック用の冷却液として底

点化性、耐久性、高熱伝導性および不活性を備える燃料

電池の冷却液を提供することを目的とする。

(0 0 0 8)

(図面を解決するための手段およびその作用・効果) 上

40 グ冷却システムを提供する。この冷却システムは、本発

明の第1の底点に保有する冷却液と、その冷却液と不活性ガ

ガス剤と、前記冷却液の導通率を保有して中性に組成す

る冷却液添加剤とを含む冷却液を提供する。

(0 0 0 9) 本発明の第1の底点によれば、低導電性、

耐久性、高熱伝導性および不活性を有す冷却液を実現

することができる。

(0 0 1 0) 本発明の第1の底点に保有する冷却液において、前記添加剤は、さらにグリコール剤を含む混合冷却液で

あつてもよい。前記冷却液は、弱アルカリ性高濃度も

より強酸性添加剤のうち少なくとも一方を含んでも良

く、あるいは、アルカリ性高濃度と酸性高濃度とを含む

ことができる。さらに、前記アルカリ性高濃度はエタノ

ールアミン系の物質であっても良い。また、前記エタノ

ールアミン系物質は、トリエタノールアミン、ジエタノ

ールアミン、およびモノエタノールアミンを含むことができる。

(0 0 1 1) 本発明の第1の底点に保有する冷却液において、前記添加剤はトリアゾール類、リン脂質および

有機リン酸剤から構成される群から選択することができます。また、前記防錆添加剂は前記冷却液を水素イオン

指標約6~約9の範囲に維持するものであっても良い。

さらに、前記防錆添加剂は前記冷却液を約100μS/cm未満の底点で車に維持するものであっても良い。また、前記防錆添加剂は特にアルミニウム材料に対して

して防錆性を有することができる。

(0 0 1 2) 本発明の第1の底点に保有する冷却液において、前記防錆添加剂は、ノニオン系物質であっても良い。また、前記防錆添加剂は、銀類および非イオン界面活性剤と酸性高濃度とを用いても良く、あるいは、ノニ

オン系物質を用いて調製してもよい。

(0 0 1 3) 本発明の第2の底点は、本発明の第1の底

点において用いた冷却液の組成並びに水素イオン指数(pH)、および比較例1~比較例6の冷却液の組成並びにpHを示す。表2は表1に示した第1実施例~第9

実施例をよりイオン化して各冷却液の特性について説明する。表1は本発明に従う第1実施例~第9実

施例において用いた冷却液の組成並びに水素イオン指数

(pH)、および比較例1~比較例6の冷却液の組成並

びにpHを示す。表2は表1に示した第1実施例~第9

実施例において用いた冷却液および比較例1~比較例6

の冷却液の比較試験結果を示す。なお、表1中においては、第1実施例~第9実施例を実施例1~実施例9とし

て示す。

(0 0 2 2)

[表1]

をほぼ中性に維持する防錆添加剂を調整し、前記基剤と前記防錆添加剂を混合し、イオン交換器を用いて前記基剤と前記防錆添加剂との混合溶液を精製することを特徴とする。

(0 0 1 8) 本発明の第4の底点に保有する冷却液の製造方法によれば、低導電性、防錆性、高熱伝導性および不活性を有す冷却液を調製することができる。なお、基剤

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(0 0 1 9) [発明の実施の形態] - 第1の発明の実施の形態:

(0 0 2 0) 以下、本発明に保有する冷却液について表1において説明する。表1は前記冷却液の特性について説明する。表2を参照して説明する。また、前記冷却液は、イオン交換器を用いた冷却液精製システムによつて精製されても良く、さらに脱イオン処理が施されていても良い。また、前記冷却液としてノニオン系物質を用いる場合には、冷却液中で防錆添加剂がイオン化せず、イオン交換器を用いることによりイオン化している不純物のみを容易に取り除くことができる。また、脱イオン処理により冷却液の品質の劣化を長期にわたり防止することができる。

(0 0 1 3) 本発明の第2の底点は、本発明の第1の底

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る。この他に、従来より防腐剤として広く用いられてきた物質には、硫酸ナトリウム、モリブデン酸ナトリウム、安息香酸ナトリウム等があり、また、溶媒の中和剤として用いられてきた物質には水酸化ナトリウム、水酸化カリウム等がある。

(0.045) また、比較例5もその性質上、前述のイオンを含むしており、2.86 ($\mu\text{S}/\text{cm}$) という高い導電率を示した。これに対して、比較例4はイオンをほとんど有しないので、8 ($\mu\text{S}/\text{cm}$) という比較的低い導電率を示した。また、従来より燃料電池用冷却液として用いられてきたイオン交換水(比較例6)は、イオンをほとんど含まないので、0.88 ($\mu\text{S}/\text{cm}$) という最も低い導電率を示した。

(0.046) 第2実施例の導電率は5.01 ($\mu\text{S}/\text{cm}$) であり、この導電率は、第2実施例の冷却液の基剤である比較例2の導電率3.46 ($\mu\text{S}/\text{cm}$) と近い値を示した。同じく第3実施例の導電率は2.11 ($\mu\text{S}/\text{cm}$) であり、この導電率は、第3実施例の冷却液の基剤である比較例2の導電率3.46 ($\mu\text{S}/\text{cm}$) より高い値を示す。この導電率は、第2実施例の冷却液を含むする比較例3の導電率1.63 ($\mu\text{S}/\text{cm}$) と近い値を示した。

(0.047) また、第3実施例の導電率は2.11 ($\mu\text{S}/\text{cm}$) であり、比較例2および比較例3の導電率(5.0 $\mu\text{S}/\text{cm}$) であり、この導電率は、第3実施例の冷却液の基剤である比較例2の導電率3.46 ($\mu\text{S}/\text{cm}$) より高い値を示す。この導電率は、第2実施例の冷却液を含むする比較例3の導電率1.63 ($\mu\text{S}/\text{cm}$) と近い値を示した。

(0.048) 比較例中のイオン濃度を増大させる防腐剤である添加剤の添加量は、通常、導電率を増大させる傾向にある。しかしながら、第2実施例および第3実施例における冷却液においては、添加剤による導電率変化は無観である。

(0.049) 第4実施例および第7実施例の導電率はそれぞれ5.3 ($\mu\text{S}/\text{cm}$) より5.0 ($\mu\text{S}/\text{cm}$) であり、この導電率は、第4実施例および第7実施例の冷却液の基剤である比較例2の導電率3.46 ($\mu\text{S}/\text{cm}$) と近似する値を示した。

(0.050) 第5実施例、第6実施例、第8実施例および第9実施例の導電率は、それぞれ、3.6 ($\mu\text{S}/\text{cm}$)、3.5 ($\mu\text{S}/\text{cm}$)、3.2 ($\mu\text{S}/\text{cm}$)、4.4 ($\mu\text{S}/\text{cm}$) であり、この導電率は、第5実施例の冷却液の基剤である比較例2の導電率3.46 ($\mu\text{S}/\text{cm}$) とほぼ同一の値を示した。

(0.051) 第4実施例～第9実施例に用いた防腐剤添加剤は、溶媒中にイオン化しないニオン系の物質であるため、理論的には導電率の示す導電率と同一の値を取ることが予測される。実験結果としての第4実施例では、いずれの実施例においても、溶媒が有する導電率とはほぼ同一、あるいは、極めて近似する値を示すことが確認された。したがって、第4実施例～第9実施例における冷却液においては、添加剤の添加による導電率変化は無観である。

電導変化は無観である。

(0.052) ここで、第4実施例において防腐剤添加剤として用いたクエルセチンについてその添加量と導電率との関係を図1を参照して説明する。図1はエチレングリコール5.0%希硫酸にクエルセチンを添加した場合の導電率の推移を示すグラフであり、横軸はクエルセチン添加量(μmol)を導電率($\mu\text{S}/\text{cm}$)を示す。図

1から理解されるように、クエルセチン添加量が7.00 μmol までは導電率は約5～6 ($\mu\text{S}/\text{cm}$) であり、添

加量によらず導電率(例えば、比較例2)が示す導電率

である。したがって、クエルセチン添加量が7.00 μmol までは導電率は約5～6 ($\mu\text{S}/\text{cm}$) である。

また、クエルセチン添加量が7.00 μmol を超えた後も

導電率は増加するものの、その値は、クエルセ

チン添加量0.00 μmol において約7 ($\mu\text{S}/\text{cm}$) で

ある。したがって、クエルセチン添加量が7.00 μmol までは導電率は約5～6 ($\mu\text{S}/\text{cm}$) である。

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（図2）第2の発明の実施の形態が適用され得る燃料電池スタッツルシステムの構成図である。
〔図3〕中電池20の横断構造を示す分解絶縁図であ
る。

実施の順序に従る冷却板を製造する工程の概略を示す筋図である。

【符号の説明】

1.0…燃料電池
1.2…スタッフ
2.0…堆肥池
2.1…空気槽
2.2…燃料槽

23...マトリックス
24...セバレータ
30...冷却セバレータ
32...外部冷却回路

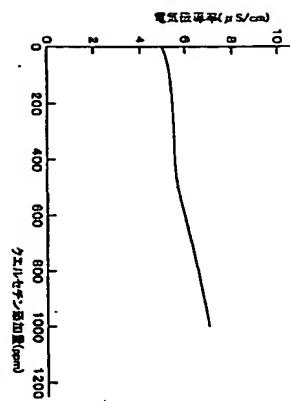
4.0…端部セバレーダ
5.0…中央セバレーダ
6.2、6.3…リブ
8.1、8.2…冷却液孔
8.3、8.4…燃料ガス孔
8.5、8.6…酸化ガス孔
8.7…溝

〔72〕発明者 谷川 正隆
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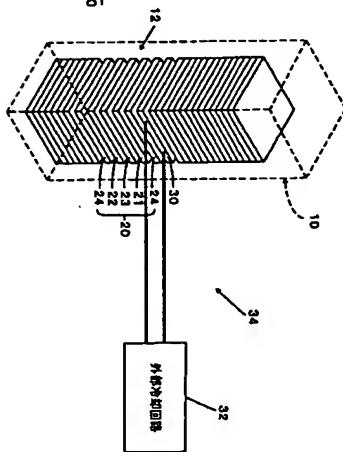
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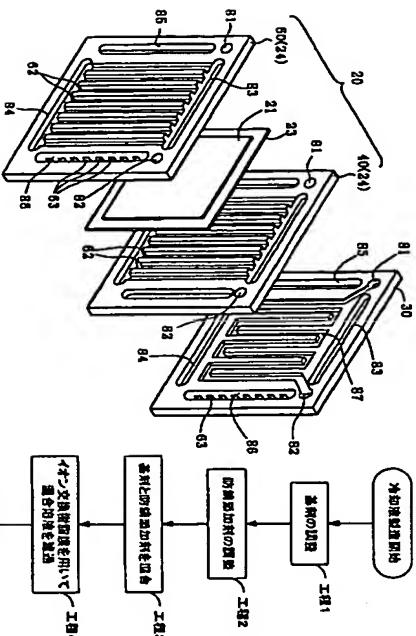
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